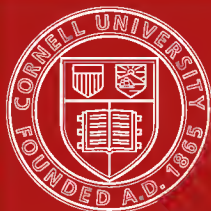


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*ON THE STRUCTURE OF THE EARTH WITH
SOME REFERENCE TO HUMAN HISTORY.*

*A
SYNOPSIS OF TWELVE GEOGRAPHICAL LECTURES
DELIVERED BEFORE THE SENIOR AND
JUNIOR CLASSES IN THE COLLEGE
OF NEW JERSEY.*

FEB. 1871.

BY

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Professor of Physical Geography in the Sheffield Scientific School of Yale College.

PRINTED FOR THE STUDENTS.

Princeton.

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D. Y.

A WORD OF EXPLANATION.

The lectures of which a synopsis is here given, were delivered at the request of the authorities of the College of New Jersey, in consequence of the ill health and absence of Prof. GUYOT. As the interval between the invitation and the delivery of the lectures was only ten days, there was but little time for special preparation, and as the classes were large and made up of students of different tastes and interests, the lecturer decided not to attempt to give in twelve lectures, a treatise, but to try to incite young men to geographical inquiries and to give them a glimpse of modern geographical progress. This may explain the selection of the themes, several of which have a bearing on the other studies of the College courses. Each lecture was given twice, varying a little in its scope, and in preparing this synopsis other slight variations have now and then been introduced.

The lecturer would acknowledge his daily obligations to Mr. ERNEST SANDOZ, whose acquaintance with the diagrams belonging to the college, and with the private resources of Dr. GUYOT, supplied the lecture-room with abundant means of illustration.

In the "References" no attempt was made to give a full bibliography, but simply to point out to the young men some of the more important works in English which are readily accessible to them in the College Library and elsewhere.

D. C. G.

NEW HAVEN, CONN.,
March 3, 1871.

SUBJECTS.

- I.—On the Scope of Modern Geographical Science; and on Maps as its Language.
- II.—On the Elements which constitute the Globe.
- III.—On the Portraiture of each of the Six Continental Masses.
- IV.—On some of the Geographical Problems of to-day.
- V.—On the Structure of the Domain of the United States.
- VI.—On the Appalachians and the Atlantic Seaboard,
- VII.—On the Mississippi Valley.
- VIII.—On the Cordilleras, and Pacific Region.
- IX.—On the River Rhine and the Adjacent Territory.
- X.—On the Mediterranean and its three European Peninsulas.
- XI.—On Palestine.
- XII.—On the Forces which are now Modifying the Surface of the Earth.

LECTURE I.

ON THE SCOPE OF MODERN GEOGRAPHICAL SCIENCE; AND ON MAPS AS ITS LANGUAGE.

REFERENCES.—Ritter's Lectures on Comparative Geography, trans. by W. L. Gage:—Ritter's Geographical Studies, trans. by W. L. Gage:—Humboldt's Cosmos:—Guyot's Earth and Man. Examples of the best topographical maps of Europe and of this country.

I. Introductory remarks.

Allusion to absence of Dr. Guyot, and to his geographical labors.

Prejudice against scientific geography and the reasons for it.

Object of these lectures; reason for the topics selected; and for the omission of other themes.

II. The earth in its entirety,—as “a star among the stars.”

III. Globe-knowledge, (*Erdkunde*) or scientific geography:

(a) As distinguished from Geology.

(b) As connected with the progress of Physics, Meteorology, Zoology, Botany, Ethnology.

(c) As illustrative of History.

(d) As a basis for political economy and true statesmanship.

IV. Two tendencies, both faulty:

(a) To overlook and disregard all physical limitations to national progress, largely exemplified in the writings of the early historians and political geographers.

(b) To undervalue the power of man in subduing the earth, and in overcoming obstacles to his progress.

(c) The intermediate position of the modern German writers.

V. The language of maps, (illustrated by various examples).

1. The various projections of the sphere.

(Cf. the articles of Hunt and Hilgard, in the U. S. Coast Survey Reports for 1853, 1855, etc).

2. Common modes of indicating elevation—

e. g. (a) By light falling vertically.

(b) By light falling obliquely.

(c) By tints.

(d) By contour lines.

(e) By reliefs and models.

(f) By profiles.

3. Different ends to be subserved by maps.

- c. g.* (a) Physical structure of land. (Orographical).
- (b) Basin of the waters. (Hydrographical).
- (c) Political subdivisions.
- (d) Historical changes.
- (e) Statistics of population, commerce, culture, etc.
- (f) Geological formations.

VI. Conventional and arbitrary signs employed by different cartographers, and the importance of always understanding the scale, projection, tints, topographical emblems, etc.

VII. Hints for the study of geography in the modern spirit of scientific exactness.

VIII. Need of personal standards of measurement.

LECTURE II.

ON THE ELEMENTS WHICH CONSTITUTE THE GLOBE.

REFERENCES.—Guyot's *Earth and Man*:—Dana's *Geology*:—Humboldt's *Views of Nature*:—*Geological Sketches* by Agassiz:—*La Terre* by E. Reclus.

- I. The Earth, as upheaved and moulded into the various forms of reliefs; classification of these forms.
- II. The Ocean, as determinative of horizontal dimensions or continental contours; classification of these forms.
- III. The Atmosphere, as mediator between the sea and the land.
- IV. The manifestation of varied structure on a small scale in any region, as distinct as in the continental masses.
- V. Mountain-Structure as dependent for its forms on the character of the constituent rocks. The value of training the eye to observe and the hand to delineate characteristic natural features. Photography as an adjunct to Geography.
(cf. Ruskin's chapters on "Mountain Sculpture," *Mod. Paint.*, vol. iv).

LECTURE III.

ON THE PORTRAITURE OF EACH OF THE SIX
CONTINENTAL MASSES.

REFERENCES.—Guyot's Earth and Man:—Dana's Manual of Geology, pp. 9-46:—Humboldt's Cosmos, vol. i. chapter on Phys. Geog.:—etc.

I. The Continents, as Individuals:

Grouped by natural resemblance.

{ Asia.
{ Europe.

{ Africa.
{ Australia.

{ North America.
{ South America.

Grouped Historically.

OLD WORLD.

Asia, Africa and Europe.

NEW WORLD.

North and South Amer. and Aust.

Grouped by Political importance.

NORTH.

Asia, Europe and N. America.

SOUTH.

Africa, Australia and S. America.

II. Consideration, in each of these land masses, of the

1. Geographical position.
2. Outline.
3. Predominant reliefs.
4. Average elevation.
5. Culminating regions.
6. Drainage.
7. Comparative amount of high and low lands.

III. Hence, the typical forms of the Continents.

Guyot's statement. Dana's statement.

LECTURE IV.

ON SOME OF THE GEOGRAPHICAL PROBLEMS
OF TO-DAY.

REFERENCES.—Petermann's Mittheilungen, 1855-71, with numerous maps:—Amer. Jour. of Science:—American Naturalist:—Journals of the Geographical Societies of London, Berlin, Paris, New York, etc.

I. Agencies at work.

- (a) the explorers and investigators in the field.
- (b) the journalists, cartographers, and students at home.

II. Interesting Problems.

1. The Physics of the Globe.
2. The laws of climate.
3. The telegraphic determinations of longitude.
4. The measurement of the figure of the earth, (a) in arcs of meridian;
(b) the 52 Parallel N. Lat., in Europe.
5. The progress of topographical Surveys.
6. Hydrographic measurements, and especially "Deep sea Soundings."

7. The existence of an open Polar Sea, and the possibility of approaching it.
8. The structure of Inner High Asia, and possible routes of transit from the interior to the Indian coasts.
9. The Lake region of Central Africa, with relation to the overflow of the Nile.
10. Central Australia.
11. The Basin of the Amazon.
12. The "Recovery" of Palestine.
13. The Western Mountains of North America.
14. Alaska.
15. Routes of transit from Europe to Asia—including the American isthmus investigations.
16. The history of early European discovery on the American continent.

LECTURE V.

*ON THE STRUCTURE OF THE DOMAIN OF THE UNITED STATES.**

- I. The North American Continent, compared with (*a*) South America ; (*b*) Asia-Europe.
- II. The geographical position of the United States, (*a*) in climate, (*b*) in boundaries, (the two oceans, the great valley, the two inland seas, the S. Gulf, the N. Lakes).
- III. The Mississippi valley,—the dominant characteristic ; its great walls, the Appalachians and the Cordilleras.
- IV. The seven distinct regions, extending from North to South ;
1. Atlantic harbors,—2. Adjacent low-lands,—3. Appalachian mountains,—4. The Great Basin,—5. The Cordilleras, from the Rocky Mountains to the Sierras,—6. The Pacific valleys, (California and Willamette),—7. The Pacific seaboard, (including the Coast Ranges.)
- V. Natural advantages of each region and consequent contributions to the national prosperity,—(1, 2) commerce and manufactures, (3) coal and iron, (4) corn and cotton, (5) gold and silver, (6, 7) commerce and agriculture.
- VI. Successive European efforts to acquire this territory and successive designations and limits of "New Spain," "New France," "New Netherlands," and "New England."

* Not including the recent Alaskan purchase,—*nor* San Domingo.

VII. The Mississippi as a boundary between the French and English. (1765).

VIII. Subsequent independence and expansion of the dominion of the United States.

- (a) The Louisiana purchase. (1803.)
- (b) The Florida purchase. (1820.)
- (c) The Texan annexation. (1845.)
- (d) The Mexican cessions. (1847 and 1854.)
- (e) The Russian treaty. (1867.)
- (f) The San Domingo en-treaty. (1871.)

The significance of all these accessions.

LECTURE VI.

ON THE APPALACHIANS AND THE ATLANTIC SEABOARD.

REFERENCES.—Guyot on the Appalaehian System, with Sandoz's Map, (Amer. J. of Sci., March, 1861, and in Petermann's Mittheilungen) :—Geological Reports of Pennsylvania, New Jersey, etc. :—U. S. Coast Survey Reports :—Maps of the U. S. Engineers.

THE APPALACHIAN RIDGES AND SLOPES :

A. *In General.* 1. course ; 2. limits ; 3. altitude, (average, culmination, depressions) ; 4. parallélism ; 5. natural subdivisions, N., Center, and S. ; E., Middle, and W. ; 6. three systems of drainage, Laurentian, Atlantic, Mississippi.

B. *In detail.*

1. The COAST line,—apparent and submerged ; Dana's maps of N. Y. harbor and of L. Isl. Sound ; Coast Survey sections across the Gulf Stream ; recent work of Count Pourtales and illustrative maps in Petermann. The bays, sounds, and harbors of this sea-board. THE GULF STREAM.
2. The ATLANTIC low-lands, narrow in north, broad at south, depressed near N. York bay ; differences between the rocky N. England coast, and the swamps and pine-barrens of the south. The work of the U. S. Coast Survey, described, and exemplified by the maps of the harbor of Portland, Chesapeake bay, etc. Recent work of the U. S. Engineers in topographical delineations of battle-fields E. of the Alleghanies, etc. Massachusetts Topographical State map. "Hydrography of Maine."

3. The Appalachian Range, and enclosed valleys.

- (a) The continuous East ridge.
- (b) The broken Western ridges.
- (c) The great valley intervening.
- (d) The average elevations.
- (e) The northern culminations, in the White, Green and Adirondack Mts.
- (f) The southern culminations in the Black and Smoky Mts.
- (g) The intermediate sinking.
- (h) The Peaks of Otter.

4. The Western Plateaux.

C. Noteworthy Reflections.

- 1. The industry of the region as determined by physical causes.
 - 2. The comparison of the Appalachians and Juras. (cf. Lesley's Topography as a Science). Ridges as folds in the strata.
 - 3. The Historical Portals through the Alleghanies,—*e. g.* (a) Lake Champlain—from Montreal to N. Y. (b) The Mohawk valley, connecting Lake Erie and the Hudson. (c) The Potomac and Shenandoah valleys.
 - 4. New England as a distinct physical region. (cf. Palfrey's Hist. of N. Eng, vol. i, for a good description of the country, with an excellent map).
 - 5. The metropolitan position of New York and reasons for its permanent ascendancy.
 - 6. Illustrations of our ignorance of the Appalachian topography.
 - 7. The formation of "Appalachian" Mountain clubs recommended.
 - 8. Example of what may be done in Dana's study of the New Haven region. Extract of a letter from a Civil Engineer.
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LECTURE VII.

ON THE MISSISSIPPI VALLEY.

REFERENCES.—Humphreys and Abbot on the Mississippi River :—the War Maps published by the U. S. Engineers and U. S. Coast Survey :—the Lake Surveys of the U. S. Engineers :—Geological Reports of Owen, Hayden, Whitney, Newberry, Safford, etc.

A. THE GREAT VALLEY.

- I. The Geographical limits and position of the valley ; its southern slope, area and natural subdivisions ; relation to the Lakes and to the Gulf.
- II. (a) The Central river, or Mississippi proper :—sources, descent, bends, volume of discharge, bayous, delta.

- (b) The Missouri tributary,—discussed in similar detail.
- (c) The Ohio tributary—(with Cumberland and Tennessee).
- (d) The five other chief tributaries, (Arkansas, Red, White, Yazoo and St. Francis).

III. Physical characteristics of the Mississippi basin.

- 1. The region of Prairies.
- 2. The region of Plains.
- 3. The region of Coast and Delta lowlands.
- 4. The hills.
- 5. Summary view of the climate, winds, soil, and products of the valley.

IV. Relations of this valley to the progress of the United States :

- 1. As an abundant source of food-supplies for the people of W. Europe,—and of the Atlantic coast.
- 2. As promoting the Union of the States; two unsuccessful attempts to divide the valley, once separating E. from W. and once N. from South.
- 3. As a war power in the recent contest.
- 4. As the seat of great cities.—New Orleans, St. Louis, Chicago, etc.
- 5. As the seat of political power, and free civil institutions,—in contrast with what would have been the case if France, or Spain had maintained its ascendancy.

B. THE NORTHERN LAKE SYSTEM.

- 1. A sort of "Mediterranean" sea.
- 2. The natural outlet of the St. Lawrence.
- 3. The artificial outlet in the harbor of New York.

C. THE GULF OF MEXICO.

- 1. The notion of a Gulf Confederacy never realized.
- 2. The relation of the Gulf to interoceanic transit—the isthmus routes, the W. India islands, Lower California, etc.

LECTURE VIII.

ON THE CORDILLERAS, AND PACIFIC REGION.

REFERENCES: The Map of Gen. Warren, published by the U. S. Engineers; and the General Military Map of the U. S., published by the same corps; the Land Office Map; the Guyot Map. The numerous reports of the Government and of the State Surveys, especially the Publications of the Geol. Surv. of California, and of the U. S. 40th Parallel. Recent Travels.

I. The three epochs of Western exploration, beginning with

- 1. The "Louisiana" purchase.
Discovery of the Columbia R. by Lewis and Clark.
The Trappers and Fur traders.
- 2. The Mexican purchase.
Discovery of Gold and consequent explorations for the Pacific R. R.
- 3. The threatened dissolution of the Union, and consequent necessity for the construction of the P. R. Road.

II. The recent lines of investigation.

- (a) The Union and Central Pacific R. R.; and the Survey of the Fortieth Parallel.
- (b) The Northern Pacific R. R.; and the work of the N. W. boundary.
- (c) The Southern Pacific R. R.; and the work of the Mexican boundary.
- (d) The Geological Survey of California.
- (e) Hayden's Geological researches.
- (f) Other less extended explorations.

III. General Views of the region.

1. Proposal of the name "Cordilleras" of the U. S., by Prof. J. D. Whitney; comparison of this region of upheaval with the Cordilleras of the Andes, and with the Cordilleras of Mexico.
2. The Rocky Mountains.
 - (a) The "divide" in the north,—sources of three great river systems.
 - (b) The middle passes, and adjacent summits.
 - (c) The peaks and parks of Colorado,—and the four great rivers originating in this region, (Platte, Arkansas, Del Norte, Colorado).
3. The Interior Plateau, or "Basin," so called; its mountain ridges; its salt lakes, and sinks; its river courses.
4. The Sierra Nevada and Cascade Mountains.

The noteworthy distinction between the southern ridges and the northern volcanic cones.
5. The valleys of the Sacramento and San Joaquin, the Willamette and Puget Sound.
6. The Coast Ranges.

IV. Regions of marked interest and importance.

1. The lofty mountains of Colorado; (the measurements of Parry and Engelmann, of Whitney and Brewer, etc).
2. The Colorado Parks,—(as described by various writers, *e. g.* Gilpin, on San Luis Park).
3. The Sources of the Yellow Stone, and the Geyser region, (Hayden, Langford, etc.)
4. The Colorado Cañon, (described by Dr. Newberry, on Ives's party, and recently traversed by Maj. Powell).
5. The Great Salt Lake, (discovered by Bridger and Bonneville, described by Stansbury, etc).
6. The High Sierras of California,—including Mt. Whitney, 15,000' and several peaks above 14,000'. (described in the Geol. Surv. of Cal., vol. i, and in Whitney's Yosemite Guide Book).
7. The Volcanic peaks, Shasta, Hood, Rainier, Baker, etc., (especially with relation to Mr. King's announcement of Glaciers upon three peaks).
8. The Yosemite Valley, (cf. Whitney's "Guide").
9. The Death Valley, (Williamson's measurements).
10. Puget Sound, (Recent surveys).
11. The Shoshone Falls, (cf. Overland Monthly, Oct., 1870.)

LECTURE IX.

ON THE RIVER RHINE AND THE ADJACENT TERRITORY.

- I. The four river-systems draining the Alps; (Rhine, Rhone, Po and Danube). Resemblances between the Rhine and Rhone.
- II. The Rhine as a natural Water-course :
 - (a) Its sources, direction, and length.
 - (b) The three natural subdivisions of its course—1, to Basel, (the Gate of the Juras); 2, to Cologne, (the beginning of the Low-lands); 3, to the Sea. Two-fold divisions of these,—marked by Lake Constance, Mayence, and the first divergence at the Delta.
 - (c) Rate of descent in each stage.
 - (d) Extent and limits of the area drained by the river and its tributaries.
- III. The Rhine as a route of transit, for trade, armies, and tourists, from Sea to Summit.

Relations of Holland and Switzerland; of England and Italy. The Hanse towns. The Canal to the Rhone. The Natural Scenery.
- IV. The Rhine as the seat of social influence and culture.
 - (a) The valley,—its agriculture, harbors, coal and iron;—likewise its Episcopal sees,—baronial residences,—commercial depots,—universities,—cathedrals,—romance and poetry.
 - (b) In its neighborhood—France and Germany, as strong, ancient, bitter foes; Switzerland and the Lowlands, as minor and neutral or tributary States. Physical characteristics of each of these four countries:—1. France; 2. Germany; 3. Switzerland; 4. Holland.
- V. The Rhine as a Political Boundary.
 1. The meeting place of Kelts and Teutons; of Romans and Germans.
 2. The French tradition and claim that the river is "the natural boundary." [cf. Lavallée's *Geographie Physique et Militaire*; (Paris, 1861)].
 3. The German tradition and claim that the Vosges Mts. are "the natural boundary."
 4. Internal Dissensions among the Germans, especially with regard to the Palatinate.
 5. The six noteworthy epochs in Rhenish history; Caesar, Charlemagne, Charles V, Louis XIV, Napoleon I, William I.
 6. The Necessary Restoration of Alsace and Lorraine.

LECTURE X.

ON THE MEDITERRANEAN AND ITS THREE EUROPEAN PENINSULAS.

REFERENCE.—Admiral W. H. Smyth on the Mediterranean:—Böttger, Das Mittelmeer, (with maps), Guyot and Cameron's Map of the Ancient World.

A. "THE MIDDLE SEA."

- I. Its relations to ancient empires;—fluvial, marine, and oceanic ascendancy.
- II. Geographical Position;—(*a*) as to climes, (*b*) as to continents; comparison with the Gulf of Mexico, and of the Baltic with Hudson's Bay.
- III. Dimensions and Area.
- IV. Natural Subdivisions;—(*a*) of the great inter-continental depression—from the Atlantic to L. Aral; (*b*) of the proper Mediterranean,—into a lesser shallower W. basin and a deeper, longer, E. basin separated by Sicily, Adventure Bank, &c.; (*c*) into many nautical and historical regions.
- V. Its Sources of Supply; (*a*) *fluvial* (the six great rivers); (*b*) *thermal* (ancient and modern recognition of this fact); (*c*) *marine*, (Black S. with two tributaries); (*d*) *oceanic*, (the great current at Gibraltar).
- VI. Its constant level; erroneous notion of its difference from ocean level; enormous evaporation; encroachments of the sea upon land balanced by that of the land on the sea.
- VII. Soundings; Smyth's determinations of Adventure Bank; cables laid from Marseilles to Algiers; Alexandria to Malta; Spratt's sounding of 9600' in W. basin and of 13,800' in E. basin (between Malta and Crete).
- VIII. Currents:—great inward Atlantic current through Str. of Gibraltar; two lesser outward shore-currents; theory of a sub-marine current,—abandoned by Lyell; African current; Syrian; obvious influence of Bosphorus.
- IX. Tides: not "a tideless" sea,—but tides irregular, slight and often scarcely perceptible.
- X. Volcanic Action—Vesuvius and Ætna; appearance and disappearance of islands.

B. THE THREE EUROPEAN PENINSULAS.

(*Turkey-Greece ; Italy ; Spain*).

1. Contrast between N. and S. coasts of the Mediterranean in rivers, islands and peninsulas.
2. Comparison of the three S. Eur. peninsulas with the three S. Asiatic.
3. The three peninsulas compared with one another, in contour, in adjacent islands, in vertical structure.
4. Delineation of the characteristic features of each;—the Grecian, Roman, and Iberian.

C. THE MEDITERRANEAN HISTORY.

1. Adjacent regions as well as Peninsulas to be considered; (*a*) the primeval importance of Egypt and Syria; (*b*) subsequent dominion of Greece and Rome; (*c*) later ascendancy of France and Spain.
2. Physical reasons for historical sequences;—climates, harbors, productions, routes from Europe to the Indies.
3. Decadence of Mediterranean importance after the oceanic discoveries of the 15th century.
4. Renewal of its importance in modern times; Russia's out-look upon Constantinople; the overland and other routes to the East; the Suez Canal.
5. Progress of Christianity from the Levant to the West;—between the Germanic pagans pressing toward the Mediterranean upon the North, and the Mahommedan faith, coasting Africa on the South.
6. Constant ascendancy of Mediterranean influences,—the faith of Judea, the culture of Greece, the laws of Rome, the learning of the Arabs, the paintings of Italy and Spain, etc.

LECTURE XI.

ON PALESTINE.

REFERENCES: Stanley's Sinai and Palestine :—Robinson's Physical Geography of Palestine :—Ritter's Geography of Palestine, trans. by W. L. Gage :—Tristram's Land of Israel :—The Recovery of Jerusalem, and the quarterly Statements of the Palestine Exploration Fund : Van de Velde's Map.

- I. Special Reasons for selecting this theme: the Natural as well as the Historical peculiarities of the country.
- II. THE SYRIAN REGION including Palestine, and the region beyond the Jordan.

Its structure. The remarkable Valley from North to South, traced from between the two ridges of Lebanon, even to the Red Sea. Absence of any great cross-valley. Mt. Lebanon: Anti-Libanus and Mt. Hermon (9–10,000').

III. PALESTINE proper.

1. Its Geographical position.

Isolation from other countries.

Proximity to Egypt, Assyria, Greece.

Union of three Continents.

2. The Jordan.

Sources on Mount Hermon, -----Altitude, 3300'

First fall to Lake Merom, ----- do. 100'

Second fall to Sea of Galilee, -----Depression, 650'

Third fall to the Dead Sea. ----- do. 1316'

El Ghor.

The extraordinary depression of the lower Jordan Valley. Lynch's determinations. Characteristics of the Dead Sea Region.

3. Peræa and the country East of the Jordan.

Count de Vogüé's paper on the Hauran.

J. L. Porter's Giant Cities.

Need of further researches.

4. Hilly region West of the Jordan.

Lofty northern part. (Mt. Jermuk 4000').

Plain of Esdraelon (nowhere over 400').

Southern Ridge (Mts. Ebal and Gerizim 2650'; Olivet 2724'; Hebron 2800').

Transverse Ravines.

Routes of Transit.

Sites of Great Cities.

5. Low Lands of Coast.

Lack of Harbors; Jaffa.

Contrast with North Coast; Tyre, Sidon, Beirût, &c.

Break at Mt. Carmel; the two sections

Terrace-like rising.

6. Profiles illustrated by Van de Welde's Maps: *e. g.* Jaffa to Dead Sea.

Jerusalem above Jaffa, 2600'.

Jerusalem above Dead Sea, 3900'.

Depth of Dead Sea, 1300'.

IV. Recent Researches of the British Ordnance Survey and Palestine Exploration fund. Dean Stanley's summary of Results. Proposed American coöperation.

V. Previous Investigators, especially those from this country.

VI. Confirmation of the accuracy of the Sacred Writers.

VII. Historical importance of Palestine in modern as well as in ancient times.

VIII. Comparison of California and Palestine in their structure, —suggested by Prof. Brewer and others.

LECTURE XII.

ON THE FORCES WHICH ARE NOW MODIFYING THE SURFACE OF THE EARTH.

REFERENCES.—Dana's Manual of Geology, Part iv. Dynamical Geology :—Lyell's Principles of Geology (Tenth Ed. 1869) :—Marsh's Man and Nature :—Tyndall on Glaciers.

- I. Correspondence between the forces now at work and those of past geological ages.
- II. Indications of secular changes produced by astral or cosmical influences.
- III. Magnetism.
- IV. Recent views of geologists in respect to the internal structure of the Earth.
- V. Evidences of gradual submergence and emergence of certain regions of land ;—*e. g.* subsidence of Greenland ; elevation of Sweden ; sinking of the Atlantic coast of the U. S., and especially of New Jersey. (cf. Cook's Geol. of N. J.)
- VI. Obvious agency of WATER.

(a) *Destructive.*

1. Steady erosion of Rivers ; *e. g.* *Colorado* (Newberry's observations) ; *Niagara*, (Bakewell's notes).
2. Extraordinary floods and land-slides ; *e. g.* in the *White Mts.* in 1826.
3. Glacial action ; *e. g.* in the *Alps*, (researches of Agassiz, Guyot and Desor, Forbes, Tyndall, &c.) : in the *Himalayas*, (Schlagintweit) : on the W. coast of *United States*, (recent observations of Mr. King and his associates).

Icebergs.

4. Encroachments of the Sea, *e. g.* on the coast of Holland, on the coast of England, (*e. g.* Eccles tower pictured in Lyell, 1839 and 1862) ; on the coast of Bretagne.
5. Tidal action and marine currents.
6. Noteworthy changes in River Outlets, *e. g.* Hwang-ho (visit of Dr. Martin, Am. J. of Sci., 2d ser., xlvii, p. 100 :—Report of Pumpelly in the Smiths. Contrib. 1866.)

(b) *Constructive.*

1. In Delta formations, *e. g.* *Mississippi* (Humphreys & Abbot), compared with other deltas. *Ganges* and *Brahmapootra*, (estimates of the volume of deposits by Everest, quoted by Lyell).
2. In the formation of coasts ; *e. g.* on the N. W. of the Adriatic,—present and former relation to the sea, of Ravenna, Adria, etc.
3. In the drainage of Lakes, and consequent exposure of land.
4. In the transportation of Rocks to the sea-coast,—as on the sea board of Asia Minor.

